Chetco Bar Fire Salvage Project

Hydrology Resource Report

Rogue River-Siskiyou National Forest

Gold Beach Ranger District

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3/8/2018

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Introduction

This report analyzes the effects of the proposed activities in the Chetco Bar Fire Salvage Project to water resources within the project area boundary. The project area boundary includes six sixth field watersheds including: Eagle Creek-Chetco River, East Fork Pistol River Nook Creek-Chetco River, North Fork Pistol River, South Fork Chetco River, and South Fork Pistol River. The project are is approximately 143, 047 acres. See Table 1and Figure 1 for project area subwatersheds and treatment activities.

The **Proposed Action** for the Chetco Bar Fire Salvage project includes approximately: 619 acres of ground based systems harvesting, 2, 378 of skyline systems harvesting, and 1, 093 .of helicopter systems harvesting. Temporary road construction on existing disturbance would entail approximately 12.2 miles. New temporary road construction would entail approximately 1.3 miles. Approximately 103.7 miles of open roads would also be used for log haul. An additional 26.4 miles of alternate haul routes have been identified in the event of road failures.

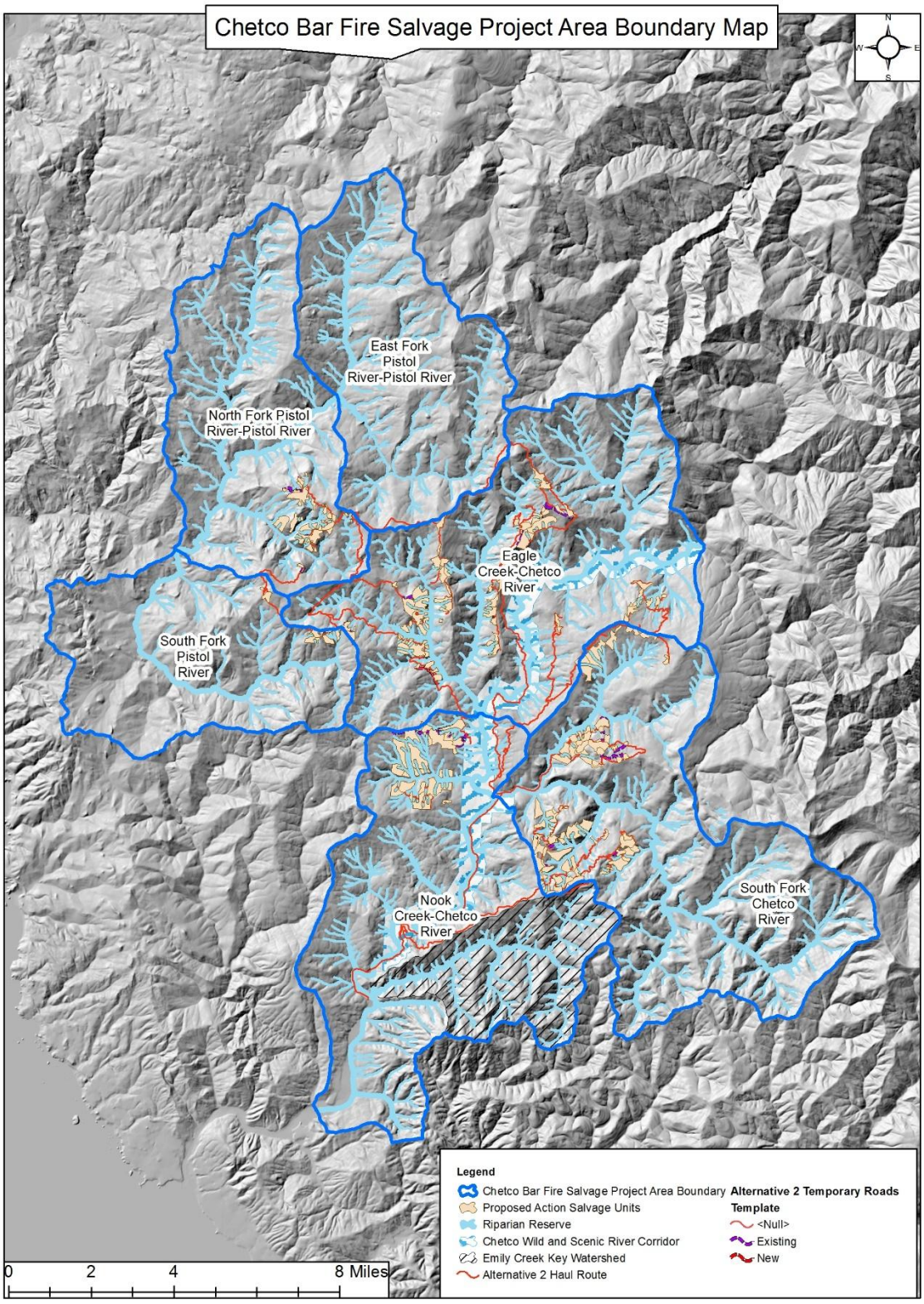
Alternative 3 includes approximately 336 acres of ground based systems harvesting, 1, 244 of skyline systems harvesting, and 288 .of helicopter systems harvesting. Temporary road construction on existing disturbance would entail approximately: 9.4 miles. Approximately 88.6 miles of open roads would also be used for log haul. An additional 26.4 miles of alternate haul routes have been identified in the event of road failures

Associated road maintenance would also occur within the project area boundary for all alternatives.

Table 1 Watershed, subwatershed, and treatment acres for Chetco Bar Fire Salvage Project.

Watershed	Subwatershed Name	Subwatershed Number	Subwatershed Acres	Treatment Acres (Proposed Action)	Percent Subwatershed Treated
Chetco River	Eagle Creek	171003120107	30, 830	1, 281	4
	Nook Creek	171003120109	29, 150	771	3
	South Fork Chetco River	171003120108	28, 821	1, 522	5
Pistol River	East Fork Pistol River	171003120401	18, 695	0	0
	North Fork Pistol River	171003120402	19, 241	389	2
	South Fork Pistol River	171003120403	16, 310	129	<1

Figure 1 Map of project subwatersheds (Project Area Boundary), Riparian Reserves, Key Watersheds, Wild and Scenic boundary, and Chetco Bar Fire Salvage Project Alternative 2 treatment units.



Management Direction and Regulatory Framework

The Northwest Forest Plan's (NWFP) Aquatic Conservation Strategy (ACS) has four components: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. It is guided by nine objectives which are meant to focus agency actions to protect ecological processes at the 5th-field hydrologic scale, or watershed, at the 6th and or 7th fields (subwatershed and or drainage), and at the site level. The Chetco Fire Salvage project area contains Emily Creek as a Tier 1 Key Watershed, managed for at risk anadromous salmonids and resident fish. There is no treatment activities proposed in the project area, with the exception of approximately one mile of road used for haul, in Emily Creek watershed. Based on the location of the road on the ridgetop, the distance from streams, and the implementation of BMPs, there would be no measureable effects to Emily Creek watershed, and will not be included in the following analysis.

Standards and Guidelines for Riparian Reserves are located on pages C-30 through C-38 in the Northwest Forest Plan (NWFP). Timber harvest is prohibited in Riparian Reserves except where needed to attain Aquatic Conservation Strategy objectives (refer to NWFP, page B-11).

Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines. Riparian Reserves include those portions of a watershed directly coupled to streams and rivers required for maintaining hydrologic, geomorphic, and ecological processes that directly affect standing and flowing waterbodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats (NWFP, pages B-12 through B-13). Defined by the NWFP on pages C-30 through C-31 are Riparian Reserves specified for five categories of streams or waterbodies. A site potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class (NWFP, page C-31).

All federal land management activities must follow standards and guidelines (S&Gs) listed in the Siskiyou National Forest Land and Resource Management Plan (LRMP) (USDA Forest Service 1989), as amended by the Northwest Forest Plan (NWFP) (USDA Forest Service and USDI Bureau of Land Management 1994), and any applicable Wild and Scenic River Plans.

The Siskiyou National Forest typically utilizes a standard site potential tree height of 175 feet for analysis purposes. For the project footprint, a stream network was modeled using the Slope Stability and Erosion Risk Hazard model (See Soils Resource Report for further discussion). Field work verifying the presence of stream channels was used to validate the models accuracy. Currently unmapped Riparian Reserves within the project area will be identified prior to implementation of treatments by watershed specialists and/or fisheries biologists and excluded from harvest. Mapping used for analysis of the alternatives displays the following Riparian Reserve buffer widths below.

Table 2. Riparian Reserve boundaries by Stream Class.

Stream Class	Description	Riparian Reserve width (slope distance (ft) from edge of channel)
1 & 2	Perennial, fish-bearing streams	350 ft
3	Perennial, non-fish bearing streams	175 ft
n/a	Constructed ponds, lakes reservoirs, and wetlands > 1 acre	175 ft
n/a	Lakes and natural ponds	350 ft
4	Ephemeral or intermittent streams	175 ft
5	Wetlands < 1 acre, and unstable or potentially unstable areas	25 ft

Water quality in Oregon is managed in compliance with Section 303(d) of the 1972 Federal Clean Water Act by the Oregon Department of Environmental Quality (DEQ) and the U.S. Environmental Protection Agency (EPA). DEQ is responsible for designating streams and water bodies that require effluent limitations, and, for developing Total Maximum Daily Load (TMDL) allocations that will ensure water quality standards are met. The most recent listing of impaired waters is available on a DEQ website as "Oregon's 2012 Integrated Report" (http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp). On National Forest System lands, water temperature is the water quality parameter of most concern in this area.

Executive Orders

The following Executive Orders pertain to this project:

• Executive Order 12088 requires Federal compliance with pollution control standards (i.e. the Clean Water Act).
• Executive Order 11988 requires agencies to avoid adverse impacts associated with the occupancy and modification of floodplains.
• Executive Order 11990 requires agencies to avoid adverse impacts associated with the destruction or modification of wetlands

Spatial and Temporal Scale

Project treatment activities are within the Chetco River and Pistol River watersheds. Figure 1 illustrates the project area boundary to be used as the spatial bounds for the hydrologic analysis. This includes subwatersheds: Eagle Creek-Chetco River, East Fork Pistol River Nook Creek-Chetco River, North Fork Pistol River, South Fork Chetco River, and South Fork Pistol River.

Past, ongoing, and reasonably foreseeable projects within the activity area and within the watersheds were considered for the cumulative effects analysis. Wildfires, timber harvesting, mining, and road construction activities have occurred throughout the watersheds. Project

treatments within the subwatersheds and their effects were analyzed using the methods listed below and incorporated into the existing conditions. Ground-disturbing projects older than 1960 were not included, partly because more reliable record keeping started after 1960, recorded timber harvest activity on National Forest System (NFS) land was less intense and more widespread up to that point, and partly because it was determined that the effects of timber harvest on activities that occurred prior to that year would have minimal effects on water quality. Cumulative effects were considered out to the completion of the salvage harvest.

The direct and indirect effects of the action alternatives regarding road maintenance and temporary roads are also analyzed in terms of their immediate, short-term effects on sedimentation to streams, as well as their long-term effects that might be realized after the complete implementation of the project.

Analysis Methodology

Activities in areas that contribute water, shade, or sediment to streams or wetlands can affect water quality or quantity; therefore activities within Riparian Reserves and potentially hydrologically connected areas, such as roads, are the focus of this analysis. Treatment alternatives will be analyzed based on their potential effects to water quality, water yield, peak flow, and hydrologic function and condition. Specifically, erosion and sedimentation, stream temperature, water yield, peak flow, and waterbody condition will be analyzed through the measures outlined in Table 2. Since there are not treatment activities proposed, with the exception of haul, there would be no measureable effects to the Hydrology Outstandingly Remarkable Value (ORV) for the Chetco River Wild and Scenic River, and therefore will not be included further in the analysis.

Table 3.Hydrology Measure and Issues for the Chetco Bar Fire Salvage Project.

Issue	**Measures**
Erosion and Sedimentation	• Acres of soil detrimentally impacted in Riparian Reserves. •Miles of temporary road constructed or used.
Stream Temperature/303d listed streams	• Acres harvested in riparian reserves.
Water Yield and Peak Flow	• Acres of soil detrimentally impacted in riparian reserves. • Acres of soil detrimentally impacted in potentially hydrologically connected areas. • Road density/ location • Number of live trees removed.
Waterbody Condition	• Alteration of stream/lake bank and bed stability measured by changes in sedimentation, and water yield using measures described above. • Acres harvested along stream or lake banks. • Acres harvested in potential large wood recruitment areas in riparian reserves.

The Project Area Boundary for hydrologic analysis of direct, indirect, and cumulative effects of Chetco Bar Fire Salvage project includes the six subwatersheds where treatments are proposed. Acres of treatment for the Action Alternatives within each subwatershed within the analysis area are shown in Table 4.

Table 4. Acres of harvest units within each subwatershed in the project area boundary.

Subwatershed	**Subwatershed Total Acres**	**Alternative 2 (acres treated)**	**Alternative 3 (acres treated)**
Eagle Creek	30, 830	1281	502
East Fork Pistol River	18, 695	0	0
Nook Creek	29, 150	771	510
North Fork Pistol River	19, 241	389	99
South Fork Chetco River	28, 821	1, 522	680
South Fork Pistol River	16, 310	129	79
Total	**143, 047**	**4, 091**	**1, 869**

Past, present and reasonably foreseeable projects within the Analysis Area were evaluated to determine potential cumulative effects from the project. These activities are shown in Chapter 2 of this EA.

The Chetco Bar Fire is the most recent, largest-scale disturbance in the Analysis Area, and effects from the fire are discussed throughout the affected environment and existing condition, direct and indirect effects, and cumulative effects sections of this report. This report uses both burn severity and burn intensity to describe potential watershed changes from the Chetco Bar Fire, and potential interactions with treatments in the Chetco Bar Fire Salvage. Burn severity describes the effects of the fire on soil structure, infiltration capacity, and biotic components. It is used to indicate runoff and soil erosion potential from the fire. Burn severity maps were produced and field-verified as part of the Burned Area Emergency Response (BAER) assessment for the Chetco Bar Fire. Burn severity is defined through differences in surface organics, duff cover, and characteristics of mineral soils (Debano et al, 1998):

- Low severity – low soil heating, litter scorch or consumption with duff largely intact, mineral soil is not changed.
- Moderate severity – litter consumption with moderately charred or consumed duff, no visible alteration of mineral soil surface.
- High severity – complete consumption of duff and mineral soil surface visibly reddish or orange color. Acres burned in each subwatershed by severity are shown in Table 5.

Burn intensity describes fire effects to vegetative characteristics including tree mortality and consumption of understory vegetation and down wood.

- Underburn-<25% tree mortality, live green tree crowns predominate.
- Mixed mortality- 25-50% tree mortality, tree crowns are generally not consumed.
- Mixed Mortality- 50-75% tree mortality, tree crowns are generally not consumed.
- Stand replacement->75% tree mortality, tree crowns are generally consumed.

Acres burned in each subwatershed by intensity are shown in Table 6. Treatments in the Chetco Bar Fire Salvage Project are located in areas that experienced mixed mortality and stand replacement conditions in the Fire.

In this report, burn severity is used to understand and predict effects from potential erosion increases. Burn intensity is used to understand and predict changes in water yield, peak flows and canopy cover.

Based on acres proposed for treatment (direct and indirect effects) and the number of acres affected by the Chetco Bar Fire (cumulative effects), the Eagle Creek and South Fork Chetco River subwatersheds have the highest potential for direct, indirect, and cumulative effects; however, as discussed in the Effects Analysis there are no significant or long-term direct, indirect, or cumulative effects expected from the Chetco Bar Fire Salvage Project. The treatment stands in East Fork and South Fork Pistol River subwatersheds have less than 1 percent proposed treatment acres for all action alternatives. In addition, treatment stands in Nook Creek and North Fork Pistol River subwatershed have less than or equal to 3 percent proposed treatment acres for all action alternatives.

Table 5.Subwatersed acres of soil burn severity within Chetco Bar Fire.

Subwatershed	**High severity (acres)**	**Moderate severity (acres)**	**Low severity (acres)**	**Total burned high and moderate severity (acres)**	**% SWS burned by high and moderate severity fire**
Eagle Creek	3, 497	12, 373	10, 779	15, 870	51
East Fork Pistol River	120	3, 081	4, 771	3, 201	17
Nook Creek	1, 660	2, 166	4, 543	3, 826	13
North Fork Pistol River	363	1, 913	3, 609	2, 276	12
South Fork Chetco River	1, 406	6, 387	14, 236	7, 793	27
South Fork Pistol River	6	341	897	347	2

Table 6. Subwatershed acres burned by intensity within the Chetco Bar Fire Salvage project.

Subwatershed	**Stand replacement**	**Mixed mortality (acres)**	**Underburn (acres)**	**%SWS burned by stand replacement**

				fire
Eagle Creek	909	364	8	3
East Fork Pistol River	0	0	0	0
Nook Creek	722	49	0	3
North Fork Pistol River	182	195	11	1
South Fork Chetco River	1, 091	427	4	4
South Fork Pistol River	56	72	1	<1

Project Design Criteria/ Best Management Practices

A complete list and discussion of best management practices (BMPs) and project design criteria (PDC) are included in Chapter 2 of this EA. BMPs and PDC were developed for the Chetco Bar Fire Salvage project using the National Core BMP Technical Guide (USDA Forest Service 2012), monitoring studies, and the best available science. BMPs and PDC are discussed throughout the effects analysis of this report and are the primary mechanism to mitigate potential hydrologic effects from the project.

Table 7. Project design criteria, best management practices, and mitigation measures for the Chetco Bar Fire Salvage project.

• Exclude Riparian Reserves as defined by **Error! Reference source not found.** from harvest and new disturbance (i.e. temporary roads, landings, and skid trails) to protect water quality and riparian resources. A Hydrologist, Soil Scientist, and/or Fisheries Biologist will assist in field validation and identification of currently unmapped Riparian Reserves prior to implementation and layout.
• No new temporary roads is proposed nor allowed within Riparian Reserves. Existing legacy templates may be used after review and approval by Hydrologist, Soil Scientist, or Fisheries Biologist in Riparian Reserves if rehabilitation occurs post-harvest, which would meet ACS objectives by restoring riparian-dependent conditions. See Soils PDCs for effective obliteration measures.
• No new skid trails and landings will be constructed within Riparian Reserves (including wetlands and springs).
• Reconstruction or maintenance of roads would not be done when soils are saturated or run-off occurs, to minimize erosion and sedimentation.
• Yarding activities should achieve full suspension over active channels. To facilitate log suspension with skyline operations, corridors for cable rigging would be allowed to pass through Riparian Reserves. A maximum clearing width of 12 ft. is required and logs may be yarded through this corridor if necessary. Corridors must be spaced at a minimum of 200 feet apart if they pass through Riparian Reserves. Corridor “rub trees” within the Riparian Reserve, even if damaged, will either be left standing or felled and left in place.
• Reuse of existing templates within 100 feet of streams needed to access treatment units could be reused, if approved by the soils scientist, hydrologist and/or fisheries biologist, but would then be rehabilitated to improve infiltration capacity over pre-treatment conditions (subsoiled to break up compaction, etc.).

Affected Environment and Existing Condition

The Chetco Bar Fire Salvage project is located within two 5th field watersheds in the Chetco Sub-basin. The majority of the project footprint is within the Chetco watershed, however, the project footprint also includes the Pistol River watershed. There is less than 1 percent treatment proposed in the project area boundary for East and South Fork Pistol River within the Pistol River watershed. Thus, these subwatersheds will not be included in the following analysis. Treatment acres within the project area boundary are described in Table 1.

There are approximately 602 total miles of stream in the project area boundary. There are an estimated of 160 miles perennial, fish bearing streams; 419 miles of perennial, non-fish bearing streams, and 23 miles of intermittent and ephemeral streams. However, riparian reserve modeling has added an additional 24 miles of intermittent and ephemeral streams (refer to the soils assessment for additional information on the Slope Stability and Erosion Risk model).

Additional miles of streams is likely to be found during layout and implementation. The drainage density is approximately 2.7 miles of stream per square mile within the project area boundary.

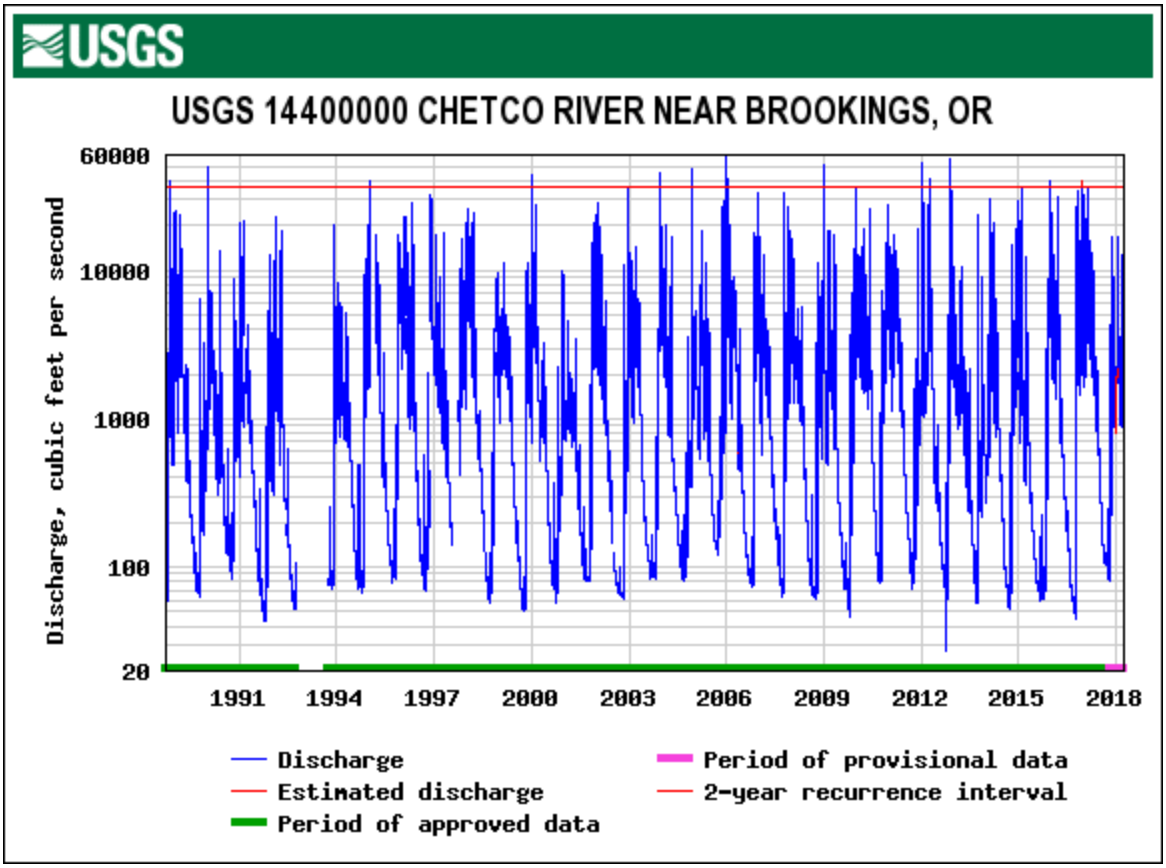
Stream Type	**Length Miles**
Perennial, Fish bearing (Anadromous)	
Basin Creek	0.4
Big Redwood Creek	0.4
Chetco River	25.3
Eagle Creek	3.0
East Fork Pistol River	2.5
Emily Creek	7.0
Little Emily Creek	1.1
Meadow Creek	1.3
Mill Creek	1.0
Mineral Hill Fork	3.9
Mislatnah Creek	3.0
No Name	5.6
Nook Creek	0.8
North Fork Pistol River	2.8
Pistol River	11.0
Quail Prairie Creek	3.3
Red Mountain Creek	0.4
South Fork Chetco River	13.1
South Fork Pistol River	1.7
Sunrise Creek	1.1
West Coon Creek	3.2
Wilson Creek	0.5
Total	**92.4**
Perennial, Fish-bearing (Resident)	
Basin Creek	1.7
Big Redwood Creek	0.8
Blue Slide Creek	1.2
Cedar Creek	0.7
Coon Creek	1.1
Craggie Fork	1.4
Dry Creek	0.2
Eagle Creek	3.0
East Fork Pistol River	2.1
Elk Creek	0.2
Emily Creek	0.8
Koontz and Davis Creek	0.4

Mill Creek	0.6
Mineral Hill Fork	1.3
Mislatnah Creek	1.2
No Name	24.9
Nook Creek	2.9
North Fork Pistol River	4.3
Panther Creek	2.1
Pistol River	1.0
Quail Prairie Creek	2.9
Rainbow Creek	0.2
Red Mountain Creek	1.4
Robinson Spring Creek	1.7
Second Creek	0.3
South Fork Chetco River	0.5
Sunrise Creek	3.9
Wilson Creek	0.9
Windy Creek	3.9
Total	**67.6**
Perennial, Non-fish bearing	
Basin Creek	0.3
Big Redwood Creek	0.4
Blue Slide Creek	0.7
Cedar Creek	0.6
Coon Creek	0.2
Craggie Fork	0.8
Dry Creek	1.2
Eagle Creek	0.7
Emily Creek	0.6
First Creek	1.1
Koontz and Davis Creek	1.0
Left Redwood Creek	0.8
Little Emily Creek	0.8
Meadow Creek	1.7
Mill Creek	0.4
Mineral Hill Fork	0.8
Mislatnah Creek	1.0
Nell Creek	1.5
No Name	393.9
Nook Creek	1.1
North Fork Eagle Creek	0.3
North Fork Pistol River	0.5

Panther Creek	0.5
Pistol River	0.9
Prairie Creek	1.2
Quail Prairie Creek	0.7
Rainbow Creek	1.1
Red Mountain Creek	1.1
Robinson Spring Creek	0.4
Second Creek	0.9
South Fork Chetco River	0.4
Sunrise Creek	0.2
West Coon Creek	0.4
Wilson Creek	0.5
Windy Creek	0.5
Total	**419.1**
Intermittent/ Ephemeral Streams	
Elk Creek	1.1
No Name	12.0
South Fork Pistol River	9.6
Total	**22.7**
All Stream Total	601.9

The hydrology of the Chetco River is complex and varied. As shown in Figure 2, discharge on the Chetco River can be very flashy. The majority of the subwatersheds in the project area boundary are within the rain dominated zone below 2500 feet, and contain a mean annual precipitation of 122 inches. Streamflow on the Chetco River has been recorded at the United States Geologic Survey (USGS) Gage No. 14400000 since October, 1969. Data from the Chetco River gaging station showed that average peaks flows were 29, 016 cubic feet per second cfs) during storm events to 61 cfs during average low flows (USDA 1996). The Pistol River watershed does not have a streamflow gage, and therefore streamflow data is unavailable. The majority of the subwatersheds within the Pistol River watershed are also within the rain-dominated zone. Winter storms bring high flows and the transient snow zone contributes to even higher peak flows when warm rains melt an existing snow pack.

Figure 2. Stream flows recorded in USGS from 1984 to 2018.



Watershed Analysis Summaries- Prefire conditions

Chetco Watershed (USDA, 1996)

Channel Morphology- Physical Characteristics

Eagle Creek

Eagle Creek is very rugged. According to the Chetco River Watershed Analysis, surveys of Eagle Creek in 1980 noted multiple log jams and waterfalls in the steep inner gorges with near vertical walls. Named tributaries of Eagle Creek are Mineral Hill Fork and Robinson Spring Creek. Tributaries are very steep and unstable due to the faults and sheared and erosion resistant volcanic rocks. Stream channels reflect the high natural and human-caused disturbance (timber harvest and road construction) levels (USDA, 1996).

Nook Creek

At the time of the watershed assessment, Nook Creek had had the greatest amount of harvesting in its subwatershed. Before 1978, approximately 45 percent had been harvested, and since then 28% (USDA, 1996). The hydrology of the channel may still be experiencing continued effects USDA, 1996).

South Fork Chetco

The South Fork Chetco flows from a steep (>10%) to a low gradient (<1%) within an inner gorge with steep, unstable side slopes that contribute to large amounts of sediment. The large terraces and depositional bars in the Chetco River may be indicators that the sediment carried within the South Fork is transported and not deposited within the mainstem of the South Fork Chetco River. There is little large wood in the channel, however this is most likely due to high stream energy. Named tributaries of South Fork Chetco River are Quail Prairie, Coon Creek, Red Mountain Creek, West Coon Creek, and Basin Creek. According to the Chetco River Watershed Assessment, surveys of Red Mountain Creek found it to be steep, with step pools, cascades, and falls; surveys of Basin Creek found cascades, rapids, and large wood; West Coon Creek surveyors also observed large wood within the channel (USDA, 1996). Quail Prairie Creek has two forks, known as the north and south fork. Stream surveys of the south fork noted human caused disturbances that have changed the natural sediment regime. Landslides were noted to be at four locations along the reach. Riffles and pools, as well as, log jams were also noted (USDA, 1996). The north fork and South Fork Chetco mainstem were noted to have had erosion and sedimentation effects from historical harvest and road management activities, since these surveys were conducted in 1987, time would have allowed for tree re-growth and recovery of these sites, and it would be expected to be mostly recovered in terms of these sources of erosion and sedimentation.

This subwatershed offers high value spawning and rearing habitat for Chinook and steelhead as well as trout (USDA, 1996).

Stream Temperature

Warmer stream temperatures are naturally occurring in the Chetco River watershed. This is attributed to the limited vegetation for shading in the headwaters due to ultra-mafic soils, and also to the wide, single channel characteristic of the main stem that lacks riparian vegetation. Loss of shade from large trees due to timber harvest and Port-Orford-cedar root disease may also have contributed to warmer stream temperatures.

Sedimentation

Sediment processes are largely a function of slope and gradient, with the added factor of human influences. Steep inner gorge landforms with accompanying landslides are the main drivers of sediment delivery to streams. Older, dilapidated road networks existing in the watershed exacerbate the occurrence of landslides and sediment delivery. Increased fuels due to fire suppression amplifies the risk of higher intensity fires which would further degrade the stability of steep slopes in the watershed. Areas exposed to high intensity fires would lose root strength and increase the risk of debris flows (Chetco River Watershed Analysis, USDA, F.S. Pacific Northwest Region, 1996).

Turbidity

The Chetco River has high quality water that when disturbed by storm events causing turbidity. Increased sedimentation due to human influence has been observed, however turbidity has not been a chronic issue.

Riparian Vegetation

Conifer forest is the most common type of riparian area in the watershed and also contains the highest amount of human influence. Hardwood, meadow and ultra-mafic riparian areas also occur in specific environmental conditions and provide special and unique habitats. Hardwood

riparian areas occur where conifer areas have been disturbed or where groundwater is lacking. Meadows occur in areas with a high fire frequency and hydric soils. Ultramafic conditions occur mostly in the higher reaches and is home to the Port Orford and incense cedars.

Roads

At the time of the watershed analysis in 1996, the road density within the non-wilderness area of the Checto watershed was 2.6 miles per square mile. This accounts for much of the project area and includes the Middle, Lower, North, and Upper Chetco subwatersheds Older networks of roads built midslope in steep areas lack design features that help prevent erosion. High levels of timber harvest and road construction has altered hydrologic patterns from the mouth of the Chetco River to Eagle Creek. (Chetco River Watershed Analysis, USDA, F.S. Pacific Northwest Region, 1996)

Large Wood

The main stem and the riparian areas of the Chetco River is deficient in structure, especially large wood. This is because of past logging operations and stream cleanouts that removed natural wood from logging areas and upstream of roads in order to reduce the hazards of logjams. The main stem of the Chetco River is deficient in large wood mainly because of its wide channel coupled with high winter flows that flush debris downstream. Most tributaries have high amounts of large wood with the exception of ones that occur in ultramafic areas or that have been scoured by debris flows (Chetco River Watershed Analysis, USDA, F.S. Pacific Northwest Region, 1996).

Channel Erosion

The Chetco River watershed historically consisted of well-developed conifer forest riparian areas that are naturally protected from excessive channel erosion due to structural diversity of plant communities and established wetlands. Fire, landslides, grazing, logging and road construction all contribute to channel erosion and morphology. The riparian areas have been heavily impacted by human disturbances that influence channel erosion. “Stream cleaning” and the removal of large structures in the channel during the mid-20th century caused increased stream velocity and energy. This contributed to channel scour, increased peak flows, bank instability and sediment transport.

Pistol River Watershed (USDA, 1998)

Stream temperature

It is thought that the warmer temperatures in the Pistol River watershed is due to streamside harvesting and road construction. Logging along the streams removed much of the shade, and road construction created broader, flatter channels that collect sediment and heat more quickly.

Sedimentation

Natural sources of sedimentation into streams is caused by landslides in the inner gorges and tributary headwalls and by mass movement triggered by saturated soils due groundwater flowing through the highly fractured underlying geology. Human activities such as road construction and timber harvest dramatically increase the sediment delivery to streams.

Turbidity

Turbidity in the Pistol River watershed is typically caused by storms and clears quickly. Areas with higher levels of human activities that increase peak flows and erosion have affected the frequency and duration of turbidity.

Riparian Vegetation

The Pistol River watershed is made up of the four types of riparian areas: conifer forest, hardwood forest, meadow, and ultramafic. Confer forest is the most common type and is located in areas with more productive soils. Because of the tall conifers that naturally occurred, these areas have been more disturbed by human activities. Hardwoods often come in after disturbances in the conifer riparian areas. The ultramafic riparian areas mainly occur in the North Fork Pistol drainages and have higher stream temperatures due to less conifers and vegetation. Port-Orford-Cedar occurs in this area and provide lasting structure to streams due to is low rate of decomposition.

Roads

During the watershed analysis in 1998, the road density of the subwatersheds ranged over 2.0 to 4.24 miles per square mile. A study showed that sedimentation rates from roads within the Pistol River watershed produced sediment up to 32 times that of the surrounding undisturbed forest lands.

Large Wood

Historically, large woody debris entered the streams from nearby fallen conifer trees and from landslides delivering wood into streams. A large portion of the watershed has been either clear-cut or managed for agriculture and settlement that has ultimately depleted the system of large wood.

Channel Erosion

Pistol river streams are steep, incised inner gorges that mainly form transport reaches. Only the lower South Fork and the main stem downstream have well developed flood plains. The impact of timber harvest and road construction increased peak flow and sedimentation and caused channel erosion and bank instability. It also has caused an excessive buildup of sediment in the lower South Fork and main stem of the Pistol River. No available information regarding the North Fork Pistol River subwatershed was able to be retrieved to characterize the site specific conditions of the channel morphology and physical characteristics.

303 (d) Listed Streams

The State of Oregon is required under Section 303(d) of the Clean Water Act to identify waters that do not meet water quality standards. Several streams within the project area boundary were considered water quality limited by the Oregon Department of Environmental Quality (ODEQ) and were placed on the 303(d) list beginning in 1998. Table 8 identifies the streams, the parameters for which they were listed, beneficial uses of the stream, and the section of stream listed (river mile).

Table 8. Water quality limited streams within the Chetco Bar Fire Salvage project area.

Stream	Beneficial Uses	Parameter	River Mile
Chetco River	• Anadromous fish passage; Water contact recreation; Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life • Aquatic life • Cold-water aquatic life • Fishing; Aesthetics; Livestock watering; Water supply; Water contact recreation • Resident fish and aquatic life; Salmonid fish rearing; Salmonid fish spawning • Resident fish and aquatic life; Salmonid fish spawning; Salmonid fish rearing • Salmon and steelhead spawning • Salmon and trout rearing and migration • Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Water contact recreation; Salmonid fish spawning • Salmonid fish spawning; Resident fish and aquatic life; Salmonid fish rearing • Water contact recreation • Water contact recreation; Aesthetics; Water supply; Livestock watering; Fishing • Water contact recreation; Resident fish and aquatic life	Alkalinity Ammonia Biological Criteria Chloride Chlorophyll a Dissolved Oxygen E. Coli Fecal Coliform Flow Modification Habitat Modification pH Phosphate Phosphorus Sedimentation Temperature	0 to 39.4 0 to 57.1 2.2 to 16 39.4 to 57.1
Crook Creek	• N/A	Temperature	0 to 2.3
Eagle Creek	• Resident fish and aquatic life; Anadromous fish passage; Salmonid fish rearing; Salmonid fish spawning • Resident fish and aquatic life; Salmonid fish rearing; Salmonid fish spawning	Sedimentation and Temperature	0 to 6.8
East Fork Pistol River	• N/A	Temperature	0 to 4.6
Emily Creek	• Aquatic life • Aquatic life; Human health • Cold-water aquatic life • Human health • Resident fish and aquatic life	Alkalinity Ammonia Biological Criteria Chloride Dissolved Oxygen	0 to 8.1

	• Water contact recreation; Resident fish and aquatic life	Iron Manganese pH Phosphate Phosphorus Temperature	
North Fork Pistol River	• N/A	Temperature	0 to 2.8
Pistol River	• Anadromous fish passage; Water contact recreation; Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life • Aquatic life • Resident fish and aquatic life; Salmonid fish rearing; Salmonid fish spawning • Salmon and trout rearing and migration • Salmonid fish rearing; Resident fish and aquatic life; Salmonid fish spawning • Shellfish growing • Water contact recreation • Water contact recreation; Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Salmonid fish spawning • Water contact recreation; Water supply; Fishing; Aesthetics; Livestock watering • Water supply; Water contact recreation; Fishing; Aesthetics; Livestock watering	Alkalinity Ammonia Chlorophyll a Dissolved Oxygen Fecal Coliform Flow Modification Iron pH Sedimentation Temperature	0 to 1.1 0 to 19.8 1.1 to 12.9
South Fork Chetco River	• Aquatic life • Aquatic life; Human health • Cold-water aquatic life • Human health • Resident fish and aquatic life • Resident fish and aquatic life; Salmonid fish rearing; Salmonid fish spawning • Resident fish and aquatic life; Water contact recreation • Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life	Alkalinity Ammonia Antimony Arsenic Barium Biological Criteria Cadmium Chloride Chromium Copper Dissolved Oxygen Flow Modification Iron Lead Manganese Nickel pH Phosphate Phosphorus	0 to 13.6 0 to 13.7

		Sedimentation Selenium Silver Thallium Zinc	
South Fork Pistol River	• Anadromous fish passage; Salmonid fish rearing • Salmonid fish rearing; Anadromous fish passage	Temperature	0 to 0.5 0.5 to 11.1
Windy Creek	• Aquatic life	Biological Criteria	0 to 4.1

Chemical Contamination/Nutrients

The Forest Service National Best Management Program (BMP) was developed to improve agency performance and accountability in managing water quality consistent with the Federal Clean Water Act and State water quality programs. Forest Service policy requires the use of BMPs to control nonpoint source pollution to meet applicable water quality standards and other CWA requirements. As mentioned in Forest-wide Standard and Guidelines above for water, water quality for the Chetco Bar Fire Salvage project will be managed by implementing BMPs. Therefore, chemical contamination and nutrients will not be analyzed.

Fire

Table 9. Historic fire in 6th- field watersheds

6th Field Subwatershed	**Fire Name and Fire Year**	**Total (acres)**
Eagle Creek	Biscuit- 2002 Collier Butte- 2015 Mineral- 1979 Sunrise- 1994 Unknown- 1951 1955 1964 1968	13, 719 35 46 41 361 334 21 84
Eagle Creek Total		**14, 640**
East Fork Pistol River	Biscuit- 2002 Collier Butte- 2015 Pistol Basin- 1971	8, 682 3 542
East Fork Pistol River Total		**9, 227**
Nook Creek	Repeater- 1999 Unknown- 1952	274 502
Nook Creek Total		**776**
North Fork Pistol River	Pistol Basin- 1971	58
North Fork Pistol River Total		**58**
South Fork Chetco River	Biscuit- 2002 Devil- 1984 Unknown- 1951 1960	16, 548 4 23 259

South Fork Chetco River Total	**16, 833**

Table 9Table 9 shows the acreage of recorded fire by year of occurrence in each 6th-field watershed in the project area boundary.

The percentages of each 6th-field watershed burned since 1951 are as follows: Eagle Creek: 47%; Nook Creek: 3%; South Fork Chetco River: 58%, East Fork Pistol River: 49%, and North Fork Pistol River: <1%. . Because the percentage of the watersheds burned in Nook Creek was 3 percent and was<1% in North Fork Pistol River, and trees would have grown since these fires burned in 1971 and 1999, existing effects from fire on water yield and runoff timing is expected to be approximately zero.

In the South Fork Chetco, Eagle Creek, and East Fork Pistol River, where the change in vegetation was estimated to be meaningful, the change ranged from areas with more green trees than dead, to areas with all dead trees. In terms of impact to water yield and runoff, the areas of meaningful vegetation change in these subwatersheds would be equivalent to a partial cut. A water yield increase could potentially be detected in a timbered watershed over which 48 percent of the land received a partial cut, depending on whether the partial cut removed approximately 25 percent or more of the timber in the watershed. The water yield increase in Eagle Creek, South Fork Chetco, and East Fork Pistol River subwatersheds from fire was undetectable and minor. A timbered watershed over which 48 percent of the land received a partial cut, would be below the level at which changes to runoff timing could be detected. Consequently, it is expected that the effects of fire on runoff timing in these three subwatersheds would have been undetectable and minor.

The effects of the Chetco Bar Fire will be discussed within each indicator. Because there is no data available post-fire of the project area, professional judgment and field observations were used to qualitatively assess the anticipated short-term and long-term effects of the fire.

Undeveloped Lands

These acres of land have no history of harvest activity, do not contain forest roads, and are not designated as a wilderness area or identified as an inventoried roadless area. They are areas that have no obvious previous activity and are “leftover” areas from other analyses. Undeveloped lands within the project area boundary were not identified to have special or unique hydrologic resource values, with the exception of an estimated four acres adjacent to the Chetco Wild and River Scenic section, and undeveloped lands intersecting riparian reserves. Riparian reserves are often overlapped by management areas 1 through 10.Since the residual shape and small 4 acre parcel of undeveloped land is minor compared to other size classes of undeveloped lands, effects to this land are disclosed in the Environmental Consequences section below.

Riparian Reserves have specific requirements that must be followed to meet Management Direction. Effects to the riparian reserves from proposed project treatment activities would not differ based on the designation of land since it overlaps. Management direction and project design criteria are required to ensure compliance and avoid adverse impacts to water quality and hydrologic resources, and were developed specific for project activities in the Chetco Bar Fire Salvage project. Therefore, the description of effects are not differentiated further in the analysis. Approximately, 826 acres (20%) of undeveloped lands are proposed for salvage under

Alternative 2, and an estimated 1.5 miles (11%) of existing legacy templates reused for operations as temporary roads.

Environmental Consequences

Table 10. Measures to assess the effects from treatment activities within the Chetco Bar Fire Salvage project.

Issue	Measure	Alternative 1	Alternative 2	Alternative 3
Erosion and Sedimentation	• Acres of soil detrimentally impacted in Riparian Reserves.	**0**	**0**	**0**
	•Miles of temporary road constructed or used.	**0**	**13.5**	**9.4**
Stream Temperature/303d listed streams	• Acres harvested in riparian reserves.	**0**	**0**	**0**
Water Yield and Peak Flow	• Acres of soil detrimentally impacted in riparian reserves.	**0**	**0**	**0**
	• Acres of soil detrimentally impacted in potentially hydrologically connected areas.	**0**	**0**	**0**
	Number of live trees removed.	**0**	**0**	**0**
Waterbody Condition	• Alteration of stream/lake bank and bed stability measured by changes in sedimentation, and water yield using measures described above.	**0** **0** **0**	**0** **0** **0**	**0** **0** **0**
	Acres harvested along stream or lake banks	**0**	**0**	**0**
	Acres harvested in potential large wood recruitment areas in riparian reserves.	**0**	**0**	**0**

Alternative 1- No Action

Under the No Action Alternative, no project activities would occur; there would be no soil detrimentally impacted within Riparian Reserves and no log haul. Hillslope erosion may increase from a reduction in live canopy and consumption of organic material on the forest floor from the Chetco Bar Fire, especially in stands that burned at high intensity and soil burn severity.

The hydrologic effects of roads and the interaction between road and fire effects would continue. Roads in unstable condition would continue to deteriorate, and sediment delivery would continue to occur, especially on hydrologically connected roads that were impacted from increased runoff following the Chetco Bar Fire. There would be no improvement of road conditions on hydrologically connected roads, or haul routes in riparian reserves, except those occurring through BAER rehabilitation efforts.

There would be no reforestation activities under the No Action Alternative within the project footprint; however recovery of soil stability would occur once shrubs, grasses, and tree seedlings reestablish, which have been observed from recent field observations. Hillslope erosion may continue longer on uncompacted soils in Alternative 1 than on uncompacted soils in the Action Alternatives because tree regrowth and evapotranspiration, precipitation, and interception would occur at natural rates which are estimated to be slightly lower than in areas where conifers are planted and effective ground cover (85%) is placed in disturbed sites. Re-growth and needle-fall established since the fire would not be disturbed by mechanical treatments.

The No Action Alternative would have no direct effects to peak flows since there would be no salvage logging or connected actions implemented. Roads in poor condition would continue to intercept flow and could contribute to slight increases in peak flows. Effects of the Chetco Bar Fire could increase water yield and peak. .Although soil infiltration is naturally high in the Hydrologic Analysis Area, with overland flow rarely occurring, decreases in evapotranspiration from the Chetco Bar Fire could affect water yield and peak flows.

There would be no effect to stream temperature because no stream shade would be removed. Stream temperatures could increase through a reduction in shade from burned Riparian Reserves in the Chetco Bar Fire. Increases in channel large woody debris could mitigate these effects.

There would be no effect on waterbody condition because no project activities would occur. Between < 1% and 4% of Riparian Reserves within subwatersheds in the hydrologic analysis area experienced stand replacement conditions in the Chetco Bar Fire. In-stream wood is expected to increase as standing dead trees in riparian areas fall; however, long-term large wood recruitment would be reduced as riparian vegetation recovers. In-stream wood would help mitigate potential increases in sedimentation from the Chetco Bar Fire by creating new pools and trapping sediment.

Effects Common to All Action Alternatives

None of the Action Alternatives are proposing the salvaging of fire effected trees within the riparian area. Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines. Riparian Reserves include those portions of a watershed directly coupled to streams and rivers required for maintaining hydrologic, geomorphic, and ecological processes that directly affect standing and flowing waterbodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats (NWFP, pages B-12 through B-13). Riparian Reserves specified for five categories of streams or waterbodies (NWFP, pages C-30 through C-31). A site potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class (NWFP, page C-31). See Management Direction and Regulatory Framework section for riparian reserves widths.

Erosion and Sedimentation

Surface erosion, landslides, and stream flows increase following large fires (Everett et al. 2002, Wondzell and King 2003, and Dunham et al. 2003). Soils are particularly susceptible to increased erosion and reduction of productivity after wildland fire (Amaranthus, 1989; Beschta, 1995). Wildland fire removes ground vegetation and exposes bare soil increasing the potential for increased surface erosion. Erosion is accelerated by surface runoff or over-land-flow from precipitation. In the Chetco Bar fire area the soils have a high infiltration capacity reducing the likelihood of over-land-flow occurring. Because of the high infiltration capacity of the soils, the increase in surface erosion is less following a wildfire than may be found in other areas that have reported high rates of erosion, such as eastern Oregon, Idaho and Colorado. Research in the Pacific Northwest (Wondzell and King, 2003), and post fire soil erosion monitoring on both the Silver and Biscuit Fires support this.

The USDA Forest Service, Pacific Northwest Research Station, in association with the Siskiyou National Forest, established a 450-acre experiment (27 experimental units in five blocks) in the upper reaches of the Pistol River drainage in 1991 as part of the Long-Term Ecosystem Productivity (LTEP) project. Two of five LTEP blocks were burned by the Biscuit Fire on August 16, 2002, and one block was partly burned by the wildfire and by a back-burn lit to contain the Biscuit Fire. The two remaining blocks were untouched by the 2002 fires. Wondzell and King (2003) suggest that, based on precipitation intensity maps, surface erosion should occur in the Coastal and Cascade Mountains of the Pacific Northwest after fires, but it has not been documented in the literature.

Erosion was large on burned soil relative to unburned soil, at least at small scales. Evidence indicating large short-distance transport included controlled erosion boxes and pins. Boxes showed a relation between slope and transport for burned soil as expected. Pins demonstrated fluctuating soil surface heights (relative to the top of rebar grid-point posts). We failed to see significant movement at the base of hotly burned units (Bormann et.al. 2003)

Following the 2002 Biscuit fire, 240 erosion pin plots were established before the first winter following the fire. Plots were established on both the east and west side of the forest in an effort to quantify the effects to soils. After three winter seasons there did not appear to be a significant movement in soils due to the fires (McHugh, 2005).

The increase in erosion production varies from watershed to watershed based on the severity of the fire in the watershed, parent material, and precipitation range. Monitoring results from the

Biscuit Fire indicate that increases in post fire surface erosion on severely burned soils were not great enough to cause measurable changes in water quality or stream channel morphology.

Water Quality

Stream Temperature

Stream temperature is protected under the "Clean Water Act" and State Water Quality Standards. On March 1, 2004, new water temperature standards were adopted by the State of Oregon. Water Temperature Standards are found in ORA, Chapter 340, Division 041, Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon, 340-041-0028, Temperature. The temperature policy of the Commission is to protect aquatic ecosystems from adverse warming and cooling caused by anthropogenic activities. Several streams within the Chetco Fire area are listed as water quality limited (303 (d), "Water Quality Limited with Regards to Stream Temperature" (refer to Table 8 for specific streams).

Stream temperature is affected by channel form and by shading from channel morphology and riparian vegetation. Increased sediment loading can cause the channel to become wider and shallower, exposing more surface area to solar radiation and resulting in higher stream temperatures. It is unlikely that any action alternative will alter a stream channel enough to affect the stream temperature in any of the watersheds.

Fire killed trees in the riparian area still provide some stream shade. Removal of riparian vegetation that allows additional solar energy to reach the stream contributes to elevated stream temperature (Rishel et al. 1982; Brown, 1983; Beschta et al., 1987).

Riparian Buffers for Salvage Logging - All alternatives maintain a no cut buffer within at least one or two SPT (175 or 350 feet) on fish bearing and perennial non-fish-bearing streams to protect all remaining stream shade.

Figure 3. Riparian width contributing shade based on tree height and 70% hillslope (SHADOW model).

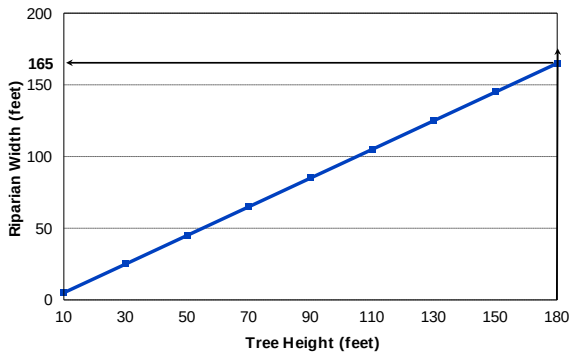


Figure 3 illustrates the riparian buffer widths required to maintain riparian vegetation that has the potential to provide stream shade. For trees 180 feet tall, the farthest tree that can provide stream shade is 165 feet from the stream. Maintaining a no-cut buffer of one site potential tree (175 feet) or greater from perennial streams adjacent to areas proposed for salvage logging

assures all potential stream shade would be maintained. All alternatives would maintain existing stream shade adjacent to areas proposed for salvage logging.

Turbidity (fine sediment delivery)

Turbidity, or the loss of water clarity, is due to the presence of suspended particles of silt and clay. Other materials such as finely divided organic matter also contribute to the loss of water clarity. Soil displacement from natural disturbance such as a wildfire or from management activities can cause sediment to be delivered to a stream. Sediment delivered to a stream most often is comprised of both fine sediment that is suspended in water and coarser materials (sands and gravels) that are transported as bedload. Suspended sediment is usually quickly transported through the stream system, but can deposit out in very low gradient areas or when flow subsides after a storm event.

Three severely burned tributaries to the Illinois River as well as the Illinois River were measured in 2002 and 2003 to determine whether any changes in turbidity occurred following the first winter after the Biscuit Fire. The winter following the Biscuit Fire was normal with one storm of magnitude of between a 2 and 5 year event that occurred the last week of December and first week of January. No increase in turbidity was noted in the fire area. The Illinois River below Six Mile Creek showed an increase on December 16 but the sediment source was upstream of the fire area.

Turbidity was also monitored following the 1987 Silver Fire for the effects of wildfire and for subsequent salvage logging. For two years following the Silver Fire turbidity was monitored, a period when sediment are at their peaks following a wild fire. Approximately 40 % of Silver Creek and 37% of Indigo Creek burned in that fire. Monitoring results showed that the maximum average monthly turbidity at the mouth of Silver Creek was measured at under 5 Nephelometric Turbidity Units (NTUs) in January 1990, about two years after the Silver fire. The maximum measured turbidity for Indigo Creed was 12-13 NTUs in January and February 1989. A summary of the data concluded: “There have been no noticeable effects in increases in turbidity or sediment” and “Turbidity does not appear to be a significant area of concern” (Kormeier, 1995).

There were reports this winter of elevated turbidity on the lower Chetco River. The source was identified to be active private log haul during winter storm events causing road fines to be delivered to the road ditch and then to the Chetco River. Oregon Department of Forestry notified the company of the situation. As mitigation measures, they placed additional road rock surfacing and put hay bales in the ditches to filter out fine sediment.

Forest Service resource specialist’s field surveyed Chetco Bar high burn severity areas during winter storm events. The small streams in these areas were running clear with no signs of streambank or channel bottom instability. Larger streams below these areas were also clear. This is consistent with the turbidity monitoring of both the past Silver and Biscuit fires that concluded elevated turbidity from the fires is not a concern.

Peak Flow

Wildfire-induced increases in sedimentation, turbidity, and summer stream temperature as well as peak runoff have the potential to adversely affect downstream values including life property, public water supplies, domestic water supplies, and irrigation uses. Other values at risk include federally listed fish including Coho salmon, as well as sensitive fish Chinook salmon, steelhead and lamprey. Following wildfires, Burn Area Emergency Response (BAER) team is assigned

with the objective to characterize post-fire hydrologic conditions in order to estimate the risk of post-fire flooding and reduced water quality and their potential impacts to downstream values.

A hydrologic model is used by the BAER team to estimates the effects of fire on peak flows. The 2002 Biscuit fire, which is in the same area as the Chetco Bar fire, had a BEAR team as well with both estimating changes in peak flow from the fires. There are different models available to use and some are a better fit for a specific area than others. The type of model selected along with the information put into it can result in different flow estimates for the same area. The design storm selected by both the Chetco Bar BAER team as well as the Biscuit BAER team was a 25-year, 24 hour rainfall event. Different hydrologic models were used.

Increases in peak flow from fires is caused mostly in high burn severity areas where the infiltration rate of water is reduced by hydrophobicity that results in water repellency. Rain that normally infiltrates flows overland causing erosion and rapid runoff that increases peak flows. The Chetco Bar BAER team concluded that peak flows would increase by 30% on the Chetco River and roughly 30% to 50% on smaller streams. This greatly increases the risk of post-fire flooding that could lead to stream and property damage, and the concern for human safety.

The Biscuit BAER team estimated only a small increase in peak flow from the fire with an increase 0.7% for the Chetco River and 2% to 13% for smaller streams. Channel cross-sections on small streams in severely burned area were monitored for the Silver and Biscuit fires to detect increases in runoff and sediment delivery. Three small stream channels on the east side of Bald Mountain, tributary to the South Fork Silver Creek, were measured in 1988, 1989, and 1995 to determine whether any changes could be found after the Silver Fire of 1987. For the Biscuit fire, two small tributaries to the Illinois River were measured in 2002 and 2003 to determine whether any changes could be found following the first winter after the Biscuit Fire of 2002: Spring Creek (.5 square miles), and an unnamed stream referred to as Annsylinn Creek (.4 square miles) were used in this study.

The measured cross-sections were compared for changes in average depth, maximum depth, width to depth ratio, wetted perimeter, area of cross section, and GINI coefficient. The GINI coefficient is a number between zero and one that is a measure of the variability in the depth of a channels cross- section. The channel measurements for both the Silver and Biscuit fire found no difference in channel response in the winters following the fire. There was no increase in sediment delivery or peak flows in severely burned areas.

As stated in Turbidity Section, Forest Service personnel field visits to severely burned areas on the Chetco Bar area over the winter also found no evidence of increased in peak flows in small channels. The Rogue River Siskiyou hydrologists have closely monitored the Chetco River stream gage during storm events post-fire and detected no indication of increased runoff from storm events. There is nothing to support any meaningful increase in peak flow from the Chetco Bar fire.

Recent literature from Grant et al. addresses the effects of forest practices on peak flows and the consequent channel response in western Oregon (Grant et al 2006). Grant et al. synthesizes the findings of an extensive array of existing literature linking forest practices in the Pacific Northwest with changes to peak flow based on the hydroregions developed by Grant et al. For basins within the transitional zone, Grant et al. found that the detection threshold for changes in peak flows occurs at 20% of watershed area harvested. While this study applies to clear-cut harvest, similarly severely burned areas result in loss of tree canopy creating open

areas where snow fall could accumulate. Most of the Chetco Bar fire area is below the transitional snow zone and located in the rain dominated zone. No increase in peak flow will occur.

A study by Jones and Grant, 1996 concluded that road surfaces and cut slopes intercept water, and road ditches act as intermittent streams, transporting water more rapidly than natural processes and can increase peak flow for a less than a 2-year return interval. No new permanent road construction or reconstruction is proposed.

Large Woody Debris

The FEMAT Report (FEMAT, 1993. page V-26) established that many riparian ecological processes are a function of distance to the channel. Many effects of riparian vegetation decrease with increasing distance from the streambank. The report concluded that, in general, 100% of the potential large woody debris (LWD) delivery to stream channels occurred within one site tree distance of the stream (FEMAT, 1993. pages V-26 and V-27). For this analysis, the LWD recruitment zone for fish-bearing and perennial non-fish-bearing streams is considered to be the distance equal to the height of one site potential tree. Because the average height of a site potential tree on the Forest is 175 feet, this distance will be used.

Based on recent research conducted on intermittent channels in the Coast Range of southern Oregon, roughly 50% of the LWD delivered to intermittent streams originates from slope instability (May and Gresswell, 2003, page 1356). A mitigation measure common to all alternatives prohibits timber harvest on active unstable areas. This mitigation alone ensures roughly 50% of potential LWD recruitment to intermittent stream channels. The remainder of LWD recruitment is delivered by direct fall. The LWD recruitment zone for intermittent streams, outside of all unstable and past-active unstable areas, is considered to be equal to the direct fall zone.

Tree blow down has been identified as the principal agent for supplying large woody material into small to medium size streams (Keller and Swanson (1979). When a tree falls in a forest, the probability of its falling into a stream is primarily a function of tree height and distance from the stream (Figure 4). The probability of a tree falling into a stream and providing coarse woody debris decreases rapidly with increasing distance from the stream (Robison and Beschta, 1990). LWM usually consists of pieces of wood that exceeds a specific diameter and/or length. Thus a diameter effective tree height (H*e the* minimum) and length of which is assumed to provide some benefit to a stream) is defined as 8 inches in diameter and 5 feet in length. The average site potential tree of 175 feet has an average diameter at breast height (DBH) of 32 inches. Considering the taper factor with height, the effective tree height is reached at 95 feet.

Figure 4 The potential fall of a tree, showing total tree height (*Ht*), effective tree height (*He*), and total arc distance (2 π*He*). **B**. Schematic view illustrating the probability of a tree falling into a stream (A) at the edge of a stream, (B) at a distance less than the effective tree height, and (C) at a distance greater than the effective tree height.

Beyond a distance of 60 feet from a stream, there is a low probability that wood that will provide benefit will be reaching the stream. At a distance of greater than 95 feet there is a 0% probability. A no-cut riparian area of 175 feet or greater for all alternatives maintains full direct fall recruitment to the stream channel.

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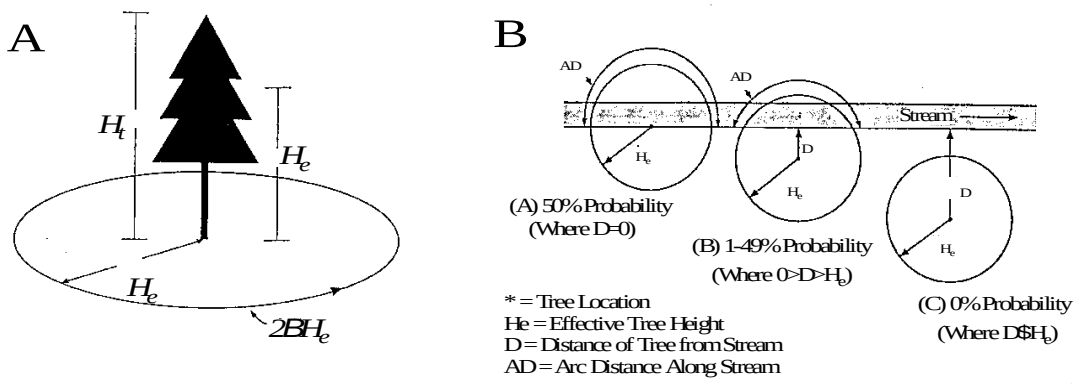

Figure 4. The potential fall of a tree, showing total tree height (*Ht*), effective tree height (*He*), and total arc distance (2 π*He*). B. Schematic view illustrating the probability of a tree falling into a stream (A) at the edge of a stream, (B) at a distance less than the effective tree height, and (C) at a distance greater than the effective tree height.

Beyond a distance of 60 feet from a stream, there is a low probability that wood that will provide benefit will be reaching the stream. At a distance of greater than 95 feet there is a 0% probability. A no-cut riparian area of 175 feet or greater for all alternatives maintains full direct fall recruitment to the stream channel.

Alternatives 2 and 3

Erosion and Sedimentation from Salvage Logging

Logging activities increase the rate of erosion through soil displacement by logging equipment, cable yarding and skidding of logs, and landing and temporary road construction. The extent and persistence of the disturbance is dependent on the logging system used and the site condition, such as soil type and the amount of ground cover present or introduced by logging operations. Numerous studies have determined that the greatest increase in soil displacement is from ground-based logging systems such as tractor logging, with the least from helicopter logging (McIver and Starr, 2000). These studies also report a range of percent ground disturbance. The percent disturbance below is based on data collected after the Silver Fire on the Siskiyou National Forest (Fong, 1992):

- Ground-based (tractor) logging 36 percent ground disturbance
- Skyline cable logging 8 percent ground disturbance
- Helicopter logging 2 percent ground disturbance

Soil displacement could result from the proposed salvage activities. Several studies have been conducted to determine the effectiveness of riparian areas in buffering sediment delivery to a stream from upslope timber harvest. Buffer widths of 100 feet were found to be effective in preventing sediment delivery from timber harvest (Corbett et at. 1978, Lynch et al, 1985, Moring 1982). A master thesis conducted in Washington concluded a 50 foot buffer as effective on slopes less than 50% with a maximum width of 200 feet on steep slopes (Broderson, 1973). All the studies assume overland or sheetflow occurs to mobilize sediment. Post fire infiltration-excess overland flow has not been reported in the Pacific Northwest (Wondzell and King, 2003).

Following the salvage of the fire killed trees from the 1987 Silver Fire on the Siskiyou National Forest, the effectiveness of riparian buffers were monitored. A summary of the monitoring results found that buffer areas were very effective in maintaining stream bank integrity as well as reducing sediment delivery (Kormeier, 1995). The Silver Fire used the following Siskiyou Forest Plan buffer widths:

- 150 feet on fish-bearing streams
- 100 feet on nonfish-bearing perennial streams
- 25 feet on intermittent streams

Both alternatives have no harvest riparian areas with a width of 175 feet or greater that exceeds the buffer width needed to protect streams from sediment delivery form salvage operations.

Increases in Peak Flow from Salvage Logging

For basins within the transitional zone, Grant et al. found that the detection threshold for changes in peak flows occurs at 20% of watershed area harvested. Most of the Chetco Bar fire area is below the transitional snow zone and located in the rain dominated zone. There will be no increase in peak flow from salvage logging, see Peak Flow section.

Timber Haul and Turbidity

Both alternative have Project Design Criteria for timber haul that mitigates the potential for fine sediment delivery from log haul in wet weather.

Landslides

New or reactivated landslides may occur during the period between the loss of root strength of dead trees and new root growth –between 5 to 12 years (Wondzell and King, 2003; Ziemer, 1981. Common to both alternatives, active landslide and unstable areas have been removed from salvage activities. Reactivation of these areas (either as a slope failure or as accelerated rates of movement on existing slides) would deliver a range of sediment and rock size, and whatever large wood was left after wildland fires. Vegetation would be reduced at the site, but productivity for aquatic and riparian organisms could increase downstream where the mix of material is redeposited. None of the alternatives include activities that will alter the natural frequencies of landslides.

Temporary Roads and Landing

There is no road reconstruction proposed in this project. Temporary roads would increase soil compaction, reduce infiltration at the road site, and potentially increase erosion in the short term until vegetative cover is restored. There would be a maximum of 13.5 miles of temporary road constructed under Alternative 2, and 9.4 miles of temporary road constructed under Alternative 3. From the 13.5 miles of temporary road proposed under Alternative 2, 1.3 miles is new construction. Temporary roads would be defined as a created travel way, for the purpose of transporting logs that is built, utilized, and decommissioned (obliterated) over the course of the treatment. Obliteration of these roads would occur at the completion of their intended use and use methods such as subsoiling to alleviate compaction and reduce concentrations of overland flow. In addition, scattering slash material to 85 percent effective ground cover would control sediment and runoff until productivity was restored. Temporary roads would include reconstruction of existing (Unclassified) roads where there is an existing road template. These temporary roads would be located near ridgelines and on gentle slopes. In addition, new temporary roads or landings would not be located within Riparian Reserves as stated in the project design criteria in Chapter 2. Therefore, there is no loss of vegetation and no effect to stream temperature from temporary roads. No sediment from temporary road construction will impact stream channel morphology of perennial, intermittent, or ephemeral streams. Thus, no increase in stream temperature would occur from channel widening due to temporary roads.

Cumulative Effects- Alternative 2 and 3

There are no measurable direct, indirect, or cumulative effects to erosion or sedimentation, peak flows, stream temperature, or waterbody condition expected from the Chetco Bar Fire Salvage project because there are no effects to the measures used to predict potential effects.

There would be zero acres of soil detrimentally impacted in Riparian Reserves or potentially hydrologically connected areas .There is approximately 1.3 miles of new temporary road construction proposed under alternative 2 that could increase erosion in the short-term, however these effects would be addressed by project design criteria. In addition, using the proposed 12.2 miles under Alternative 2 and 9.4 miles under Alternative 3 of existing roads to harvest timber reduces the need to build new temporary roads, limits soil disturbance and compaction to areas previously disturbed and compacted, and allows the opportunity to repair roads that were not built to current standards and design criteria. All temporary roads (new and existing) would be water-barred and closed after projects are completed, and erosion control measures (placement of effective ground cover (85%) and subsoiling) would be implemented. These measures are expected to prevent or minimize the potential for these roads to become chronic sources of fine sediment. In addition, drainage would be improved on haul routes through road maintenance**.**

The effect to water yield and peak flow from the Chetco Bar Fire Salvage proejct would not incrementally add to cumulative effects because no effects to evapotranspiration or compaction in Riparian Reserves or hydrologically connected areas are predicted.

There would be no acres harvested in Riparian Reserves and temperature and the 303(d) listing status of streams within the project area boundary would not be affected by the Chetco Bar Fire Salvage project.

The Chetco Bar Fire Salvage project would not incrementally add to cumulative effects because no measurable effects to sedimentation, water yield, riparian vegetation, or in-stream wood in Riparian Reserves or hydrologically connected areas are predicted. Salvage activities would not impact waterbody condition. The project footprint is 3% of the hydrologic analysis area, and

none of these treatments would occur within Riparian Reserves or other potentially hydrologically connected areas. There would be no cumulative effects to water yield and peak flows because no live trees would be harvested, and detrimental soil conditions from ground-based harvesting methods would be minimized through BMPs and PDC. There would be no cumulative effects to instream woody debris because no trees would be removed from Riparian Reserves.

Watershed Cumulative Effects

Past, present and reasonably foreseeable future activities that were considered for the Hydrology Report include: historical timber harvest since the 1980s, percommercial thinning, prescribed burning, watershed improvements, fire suppression, past wildfires, Chetco Bar Fire BAER activities, Chetco Bar fire roadside danger tree abatement, recreation, grazing, salvage logging on nearby private and BLM lands, and reforestation. The geographical scale analyzed for cumulative effects extends to the project area boundary.

Past Projects

The effects of the Chetco Bar Fire Salvage project would not add incremental effects to past activities implemented on Forest Service-managed lands in the Chetco and Pistol River Watersheds. Historical timber harvests occurred prior to BMPs. Water quality issues may have occurred more frequently during those activities. Historic activities like timber harvesting since the 1980s occurred on streambanks and removed coarse woody debris from streams. The recent timber projects implemented BMPs to control sedimentation patterns and meet water quality goals. Fire suppression has altered primary and secondary productivity and may have degraded episodic wood and sediment recruitment processes. However, it is determined these projects are no longer having an effect to hydrologic resources due to either their distance from streams and riparian reserves or the length of time that has passed since they were implemented.

Future and Ongoing Projects

Chetco Bar Fire

The Chetco Bar Fire burned 191, 197 acres crossing several lands, such as private, Bureau of Land Management, and NFS. The fire burned 170, 321 acres on NFS over several land management allocations. Salvage would occur on approximately 2% of the total area burned by the Chetco Bar Fire. Additionally, areas that are more susceptible to erosion, including Riparian Reserves, including unstable slopes would not be treated.

In terms of fire suppression for the Chetco Bar Fire, approximately 58.3 miles of dozer lines were constructed or reconstructed, as well as 51 miles of hand line. Rehabilitation and repair of areas disturbed by suppression included pulling back hand line and dozer line berms and slash and seeding with native grasses where appropriate, installing water bars on fire lines, and grading road surfaces affected by fire vehicle and equipment use. These restoration efforts will minimize the effects to riparian areas but until vegetation is established there will be some continued erosion from these bared soils into riparian areas.

It is expected there will be increased hillslope erosion and subsequent instream sedimentation following the Chetco Bar Fire, and will continue until vegetation recovery has occurred on these burned areas (at least 5 years). However, observations made during winter storms noted small streams in these areas were running clear with no signs of streambank or channel bottom instability. Larger streams below these areas were also clear. Sedimentation observed was due

to private logging activities within the project area boundary, however mitigation measures to rectify these impacts were made between Oregon Department of Forestry and company as well as Forest Service personnel. As mitigation measures, they placed additional road rock surfacing and put hay bales in the ditches to filter out fine sediment.

The Chetco Bar Fire stand mortality would continue to have the greatest influence on water yield and peak flows and stream temperature in the Hydrologic Analysis Area. Potential effects of the Chetco Bar fire on water yield and stream temperature are dependent on fire severity and vegetative condition before the fire, with areas exhibiting a high percentage live trees killed by fire having the greatest potential for increased water yield and stream temperature. However, the Chetco Bar Fire Salvage project would not impact this increase because there would be no removal of trees within the Riparian Reserves.

Chetco Bar Fire Roadside Danger Tree Abatement

Danger tree removal activities are occurring on about 250 miles of road and will continue thru 2018 and possibly 2019. Danger tree removal includes removing identified danger trees within the potential failure zone of major roads within the CBF perimeter, as well as road maintenance and reconstruction activities including: paving and repaving FS road 1376, Chetco slump, Chetco bridge and Upper Chetco bridge; culvert replacement, dust abatement, bridge work on first bridge on 1376 road, retaining wall on FS road 1376, and erosion control. The hydrologic analysis for the Roadside Danger Tree Abatement project indicated that project design criteria would be implemented and therefore no sediment delivery to streams that would affect water quality or channel morphology including floodplains would occur (USDA, 2018). In addition, no effect to the water quality of the Chetco River municipal watershed would occur; and Clean Water Act and state water quality standards would be met through actions prescribed in the project design criteria (USDA, 2018).

Chetco Bar Fire BAER Activities

Following the Chetco Bar Fire, a Burned Area Emergency Response (BAER) team was identified to conduct further fire restoration efforts. The team's task was to conduct an assessment to identify imminent post wildfire threats resulting from the Chetco Bar Fire that could impact (i) human life and safety (ii) property (iii) and critical natural and cultural resources. Majority of BAER treatments which were funded are centered on roads and recreation sites, which included:

- Road Treatments
    - Stabilization
    - Storm proofing/drainage (136 miles)
    - Inlet protection (47 points)
    - Culvert upsizing (4) or relief pipes (4)
    - Storm patrol
    - Danger trees (107 miles)
    - Gate installation (7)
    - Warning signs (74)
    - Bridge approach guard rail
- Recreation Facilities
    - Trail storm-proofing/drainage (18.5 miles)
    - Vault toilet protection
    - Dispersed recreation site barriers

    - Hazard trees
- Invasive Plants
    - Noxious weed early detection/rapid response (12,980 acres)
- Heritage Resources
    - Cultural site protection (2 sites)

Road and trail work associated with BAER in the project area boundary will have beneficial effects on aquatic resources due to long-term reductions in fine sediment from roads. Future culvert replacement projects on FSR 1909 and 1376 should reduce risk of culvert failure at these crossings. Work has either been implemented or will be accomplished by summer of 2018.

Private and Bureau of Land Management Salvage Logging

By assessing the percent of watershed with young stands, or stands less than 30 years old, the relative risk of adverse cumulative effects of the watershed can be identified. Hydrologic recovery can be assessed in terms of relative watershed risks. If less than 15 percent of the watershed is young stands, the watershed risk is considered low. If 15 to 30 percent of the watershed is young stands, there is a moderate risk, and there is a high risk if greater than 30 percent of the watershed is comprised of young stands (USDA Forest Service 1993).

The project area boundary contains private timber production lands that have been salvage logging since the containment of the Chetco Bar Fire. Using GIS analysis, there is about 13,843 acres of private land within the CBF perimeter. Approximately 4,377 acres incurred 0-25 percent basal area loss (RAVG analysis), 1,989 acres incurred 25-50 percent loss, 1,724 acres incurred 50-75 percent loss, and 5,742 acres incurred 75-100 percent loss (see Table 7). Assuming no salvage logging is taking place in areas that incurred 0-25% basal area loss, we can estimate up to 9,455 acres of salvage on nearby private lands has occurred, is occurring, or may occur in the near future. About 175 acres of salvage will occur on nearby BLM lands in the very near future.

On private land and Bureau of Land Management, 100 percent of harvested stands are expected to be young (9, 630 acres, 7 percent of the project area boundary). This assumption was made because the Forest Service does not have accurate data for the type of treatments nor stand age on private and BLM lands. GIS Analysis of burn intensity based on stand replacement acres for Forest Service- managed lands in the project area boundary showed there are 28, 390 acres of stands that are less than 30 years old (20 percent). Therefore, since approximately 27 percent (37, 750 acres) of the watershed is likely young stands, there is currently a moderate cumulative watershed risk in terms of hydrologic recovery (USDA Forest Service 1993).

Recreation

Ongoing use of developed recreation sites and trails, river access points, and dispersed use sites occurs year-round. Sightseeing, seasonally appropriate fishing and hunting, and public firewood gathering would continue to occur. Road use for recreation may impact the road surface if driven during wet conditions. However, much of this sediment will stay within the road prism and due to improved road conditions from pre-haul maintenance and BAER treatments, it is expected sediment sources would be reduced.

Grazing

There are two allotments within the project area boundary that were considered for potential cumulative effects. The allotments are: the Pistol River East and West allotment, which is vacant and there are no plans to graze over the next 5 years or longer; and the Chetco Grazing allotment, which at this time has no rest period, however the Forest Service would evaluate the allotment condition prior to allowing livestock onto the allotment. Because the effects from the action alternatives are determined to have a no cumulative effects, the action alternatives would not impact the baseline conditions from grazing.

Reforestation

There would be no cumulative effects to hydrology from reforestation. Reforestation would have a beneficial effect in areas proposed for planting. Natural regeneration surveys would be completed and if natural regeneration is determined not to be adequate, site-specific appropriate tree species mix would be planted by hand. Planting a mix of native species would have a positive effect in riparian reserves, particularly the resistant POC which should allow for re-establishment of this native species in the project area. Ultimately, some of these resistant POC should survive and contribute to long lasting decay resistant in-channel structure to the project area. A riparian plant community would be established in the riparian area and across the floodplain over time. Areas that were previously impacted from past fire would be revegetated. The conifers that were burned at stand replacement or mixed mortality conditions would be re-established with recovery time. It is unknown at this time the acres that would need to be planted because it depends on the level of natural regeneration.

Compliance with Forest Plan and Other Relevant Laws, Regulations, and Policies

Forest Plan

This project is consistent with Siskyou Forest Plan direction for soil and water resource protection because it would not measurably increase watershed impacts, over the existing conditions at the 6th field scale. The application of all BMPs to mitigate sediment effects would be required under all action alternatives. The Project Design Criteria designed for this project will also ensure that harmful effects to water quality resources will be properly and rapidly addressed. Associated new ground disturbing logging activities (i.e. temporary roads, landings, and skid trails) would not be located within Riparian Reserves. A review of the Standards and Guidelines for Riparian Reserves found that activities in the Chetco Bar Fire Salvage project are within direction of the Northwest Forest Plan (NWFP).

Clean Water Act

This project is consistent with the Clean Water Act and Forest Service responsibilities under the Clean Water Act as described in a Memorandum of Understanding (MOU) with the Oregon Department of Environmental Quality (2014) because the proposed action under normal conditions would not measurably increase watershed impacts, including sedimentation, over the existing condition.

The MOU also directs that the Forest Service cannot further degrade water quality impaired streams, although short-term adverse impacts which occur with long-term benefits are allowed. Several streams in the project planning area were on the Oregon 303(d) list for above normal

stream temperatures. All alternatives comply with the Clean Water Act, since none would raise stream temperatures, and since all follow Best Management Practices as specified in “National Best Management Practices for Water Quality Management on National Forest System Lands” (2012).

The Forest Service is directed to comply with State requirements in accordance with the Clean Water Act for protection of waters of the State of Oregon (OAR chapter 34041) through planning, application, and monitoring of Best Management Practices (BMPs), which are recognized as the primary means to control non-point source pollution on National Forest lands. BMPs would be monitored by the West Zone hydrologists, fish biologist, sale administrators, and harvest inspectors. The MOU also directs that the Forest Service cannot further degrade water quality impaired streams.

Floodplains (Executive Order 11988)

Executive Order 11988 says that Federal agencies shall avoid adverse effects to floodplains or minimize potential harm. Floodplains several to hundreds of feet wide occur in the project area boundary. The floodplains are primarily contained within Riparian Reserves. Implementation activities proposed would not impact the function of floodplains since no treatment activities are allowed within Riparian Reserves. The proposed action would avoid adverse effects to the floodplains, and thus be consistent with Executive Order 11988.

Wetlands

Executive Order 11990 says that Federal agencies shall avoid management practices that would adversely affect wetlands. Wetlands would be avoided in this project through mapping Riparian Reserves during layout and implementation.

Monitoring

Best Management Practices monitoring would occur randomly at a treatment unit within proximity of a waterbody. An interdisciplinary team would evaluate if sediment was observed exiting the treatment unit and if it was entering a waterbody. Monitoring of BMP implementation and effectiveness using the national BMP protocols has taken place on the Rogue River-Siskiyou National Forest for several years. If this occurs, an investigation would occur to identify the source of the sedimentation to understand if it is occurring from the proposed action. If the proposed action is illustrating water quality issues, corrective measures or adaptive management would be employed.

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Appendix A. Consistency Assessment with the Aquatic Conservation Strategy Objectives

Introduction

The Northwest Forest Plan requires consistency with the Aquatic Conservation Strategy (ACS) with specific reference to nine ACS Objectives. Alternatives 1 through 3 have been evaluated to determine how consistent they are with the nine aquatic conservation strategy objectives. .The Chetco Bar Fire Salvage Project Environmental Assessment (The Project), The Chetco River Watershed Analysis (WA), and The Pistol River Watershed Analysis provide the context for the responses to the Aquatic Conservation Strategy objectives. .Other specific rationale may be found in other analysis documented under other resources, e.g., Soils, Fisheries, Wildlife, Botany, etc.

Aquatic Conservation Strategy Objectives

Objective 1*—Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.*

The existing distribution, diversity, and complexity of watershed and landscape-scale aquatic features would remain on their current restoration trajectory under Alternative 1 All Action Alternatives for the CBF salvage project would maintain the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted. The Action Alternatives are expected to have no effect on aquatic resources. For the Action Alternatives a connected action will include temporary roads, however no new temporary roads would be allowed in Riparian Reserves. Best Management Practices would exclude new temporary roads in Riparian Reserves, and field review during implementation of existing templates to evaluate drainage and location, will be an effective means for eliminating localized impacts such as site erosion of flow modification. The majority of proposed temporary roads are located on ridgetops or upper slopes, and positioned away from aquatic habitat. Logging systems will employ extensive Project Design Criteria and Mitigation Measures. All of the Action Alternatives would have an undetectable effect on the watershed and landscape-scale features.

Objective 2*—Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*

The existing spatial and temporal connectivity within and between subwatersheds would be maintained under Alternative 1. No activities included in any of the Action Alternatives would sever existing linkages (movement conduits) between subwatersheds or permanently obstruct existing connections in the drainage network. Salvage logging treatments would be designed to exclude riparian reserves from any treatment activities, with the exception of log haul. Since no vegetation would be removed within riparian reserves, the dispersal of flora, fauna and water would be maintained at current conditions. Logging systems will employ extensive Project Design Criteria and Mitigation Measures across the terrestrial landscape maintaining network connections. All new

temporary roads proposed under Alternative 2 will be developed outside of Riparian Reserves, and all proposed temporary roads under all Action Alternatives would be decommissioned after use. Finally, none of the activities would chemically or physically impede routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species, especially native fish species. None of the Action Alternatives would have an effect on network connections and or create any physical obstructions.

***Objective 3**—Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

The existing physical integrity of shorelines, banks, and stream bottoms would remain under Alternative 1. The Action Alternatives require the use of the existing Forest System Road network. This network is dependent on maintained drainage systems (i.e. culverts and ditches) that allow water collection and passage to occur with minimal erosion and deposition. Road maintenance of the permanent road system associated with the project contributes to the physical integrity of the stream network. New temporary road construction is not allowed within riparian reserves, and is limited to stable areas in the upslope areas, such as ridges or generally flat terrain. These actions maintain physical integrity of riparian areas by conducting these activities outside of (or away from) riparian areas. The project would have no effect on channel configuration since Riparian Reserves are not included for treatment and runoff/streamflow changes are not anticipated. Logging systems and use of temporary roads for haul would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures.

***Objective 4**—Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

No treatment activities associated with salvage logging under Alternative 1 would be implemented, therefore existing water quality conditions would be maintained post-fire. Salvage logging treatment activities would maintain the biological, physical and chemical integrity of the aquatic system since All alternatives maintain a no cut buffer within at least one or two SPT (175 or 350 feet) on fish bearing and perennial non-fish-bearing streams protecting all remaining stream shade. It is unlikely that any action alternative will alter a stream channel enough to affect the stream temperature in any of the watersheds maintaining water quality conditions. Logging systems and use of temporary roads for haul would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures mitigating the potential for fine sediment delivery from log haul in wet weather. No new temporary roads would be constructed within Riparian Reserves, and proposed temporary road construction on existing templates do not cross surface water, so this action would not affect stream water quality. .All alternatives would maintain water quality necessary to support healthy riparian, aquatic, and wetland ecosystems because salvage logging would not prevent attainment of this objective

***Objective 5**—Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.*

Existing post-fire conditions relating to the sediment regime under which aquatic ecosystems evolved, would remain under Alternative 1. Under the Action Alternatives unstable slopes and potentially unstable slopes would be excluded from treatment activities, which would avoid sediment that could be generated by the disturbance of steep slopes, unstable areas, and high gradient

stream courses. Logging systems have been selected to avoid soil damage on steep slopes. Ground based harvest systems have been designed to operate on slopes less than or equal to 30 percent, minimizing the potential for erosion and mass wasting. By locating new temporary roads on ridges or generally flat terrain, avoiding stream crossings, and excluding new temporary road construction in riparian reserves the risk of sediment delivery from these sources would be greatly reduced. Logging systems and use of temporary roads for haul would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures. Collectively, these measures ensure that the current sediment regime is maintained. These alternatives would have no measureable effect on the sediment regime.

***Objective 6**—Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.*

Under Alternative 1 instream flows would maintain existing conditions since no treatment activities would occur. The Action Alternatives would also maintain instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing since no treatment activities would occur within Riparian Reserves. The Action Alternatives would not cause a change to existing in-stream base or peak flows within the project area. No vegetation would be removed within riparian reserves, no lives trees would be removed within the project footprint, and the majority of the subwatersheds analyzed are located within the rain dominated zone. Therefore, the treatment activities proposed under the Action Alternatives would not be sufficient to create any measurable change in water volumes/flows within the watershed.

***Objective 7**—Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.*

Under Alternative 1 no treatment activities would occur, and therefore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands would remain. The Action Alternatives would maintain the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands. Project design criteria, such as exclusion of riparian reserves and full-log suspension requirements over streams would protect floodplains. Effects to floodplain inundation and water table elevation in meadows and wetlands are not anticipated.

***Objective 8**—Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*

Existing plant communities in riparian areas re-sprouting post-fire would remain in their current trajectory under Alternative 1 since no treatment activities would occur. The Action Alternatives are expected to maintain the existing conditions of species composition and structural diversity of plant communities in the Riparian Reserves and wetlands since these areas are excluded from treatment activities. There would be some removal of vegetation associated with temporary road construction, however rehabilitation activities would occur post-harvest, such as reseeding or placement of slash material as effective ground cover to prevent surface erosion. No effects are anticipated that would affect species composition and structural diversity of plant communities within Riparian Reserves and wetlands.

Objective 9*—Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

Existing, post fire habitat conditions for riparian-dependent species would remain under Alternative 1. Habitat to support well distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species would be maintained with the implementation of the Action Alternatives. Project design criteria such as excluding riparian reserves, and locating temporary roads on ridges to avoid stream crossings are intended to maintain habitat for riparian-dependent species Implementation of salvage logging project activities would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures. Accordingly, effects to existing aquatic biota populations and habitat would not occur.